

SCIENCE INFORMATION NOTES

A collection of articles on scientific and technological
matters, research policies, science and society,
higher learning etc.

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SCIENCE INFORMATION NOTES
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Extending the Known Universe

by M. Mitchell Waldrop

Four giant elliptical galaxies — 10 billion light-years from Earth and the most distant celestial bodies ever studied — have been identified by astronomers from the University of California, Berkeley, and the Kitt Peak National Observatory, Arizona. The remotest galaxies known previously were reported 6 years ago and are at a distance of 8 billion light-years. Detection of the new objects thus increases the size of the observable universe by 25 percent; it also means that astronomers have now seen galaxies more than halfway back in time to the Big Bang, some 18 billion years ago.

"These galaxies were already pretty old looking", says Berkeley astronomer Hyron Spinrad, who coauthored the report on the findings in the 2 March Astrophysical Journal, along with doctoral candidate John Stauffer and Kitt Peak Astronomer Harvey Butcher. The spectroscopic properties of the galaxies are most consistent with an age of 6 billion years, he explains; adding on the 10 billion years it took their light to reach Earth gives a total age of 16 billion years.

"This tells you that, at least for the large ellipticals, the burst of galaxy formation happened very quickly after the Big Bang", says Spinrad. The universe was only 2 billion years old when these objects formed. "And it was over quickly, within about 1 billion years", he adds. "Otherwise we'd be seeing a lot more light from young, blue stars than we do".

Such arguments are prey to the uncertainties in galactic and stellar evolution models, he admits, but such models are thought to be fairly well understood.

The problem with doing spectroscopy on such distant and faint objects is that the light of the galaxy is swamped by the background light of the night sky, says Spinrad. He, Stauffer, and Butcher made their observations at California's Lick Observatory, which suffers from, among other things, the street lights of nearby San Jose. "The signal from the galaxies being studied was less than 2 percent of the total signal", says Spinrad. "You can still get the spectra, but it takes a long time".

Their technique was to use a Wampler scanner, a digital image tube that allowed them to subtract out the background.

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To collect enough light they had to repoint the telescope to the same galaxies again and again, building up a total of 40 hours of exposure on 23 separate nights over 3 years.

It has taken 20 years for astronomers to double the size of the observed universe from 5 billion to 10 billion light years, says Spinrad. But new detectors based on CCD's (charge-coupled devices), which have good quantum efficiency at the longer wavelengths, should soon enable astronomers to push 20 to 30 percent farther yet. "Newly forming galaxies, if they could be seen from distances up to 16 billion light-years, should be spectacularly luminous", he says.

(Science, 211, 4488 (March 20, 1981) p. 1334)

* The Lives of the Stars *

* Hans A. Bethe (Cornell Univ.) in *

* The Sciences 20(8): 6-9, Oct. 80 *

* ... "Small stars like our sun end, as someone has *

* said, not with a bang but a whimper. But stars *

* four or more times that size end with a bang. In *

* a sufficiently large star the electron pressure *

* can no longer sustain the gravitational attraction *

* of the star's matter. At that point the core would *

* collapse — in a few brief seconds. In the last *

* two years, several researchers, including Gerald *

* Brown, myself, and many others, have studied the *

* mechanism of this collapse. Apparently, the *

* entire core of the star collapses to a density *

* higher than 10^{14} , creating exceedingly high pre- *

* ssures as the material falls toward the center *

* at a velocity of 50,000 kilometers per second. *

* Ultimately, a shock wave travels outward through *

* the star—internal material moves outward while *

* on the outside material is still falling in. We *

* calculate that somewhere far out in the star's *

* periphery a separation takes place. The material *

* gets enough push from the interior shock wave to *

* overcome the gravitational attraction of the *

* star's mass and travel outward to infinity. The *

* material, containing many heavy elements, is *

* scattered throughout the galaxy." *

* (Source: Current Contents - Life Sciences, *

* 24, 5 (February 2, 1981) p 10) *

Is the Universe expanding?

by David A. Hanes

(Extracts)

The discovery by Edwin Hubble that the Universe is not static, but an evolving entity, is surely the most important finding in extragalactic astronomy this century. Few astronomers would contest the view that the Universe is in a state of general smooth expansion. However, recent provocative statistical studies by J.F. Nicole, D. Johnson, I.E. Segal and W. Segal of the relationship between the redshifts of moderately nearby galaxies and their apparent brightnesses have brought this simple yet profound picture under attack.

In a general expansion, the recession velocity of a galaxy (or empirically its Doppler redshift) should be directly proportional to the distance of that galaxy. Nicoll et al. claim they can reject such a relationship; rather, their findings imply a quadratic relationship between redshift and distance for a moderately nearby sample of galaxies (those with recession velocities less than $5,000 \text{ km s}^{-1}$). Such a discovery is consistent with the predictions of I.E. Segal's alternative world model, the chronometric cosmology, and at variance with the predictions of Einsteinian General Relativity. At the very least, these statistical demonstrations demand explanations in terms of unsuspected selection effects, subtly biased samples, or local anisotropies or inhomogeneities; and, should convincing explanations be lacking, they may suggest that the usual cosmological descriptions of the Universe are inadequate.

Edwin Hubble's original data suggested a linear relationship between velocity (inferred from redshifts) and distance (inferred from apparent luminosities) for galaxies. This relationship has an appealing simplicity, for in a universe in which we are in no preferred position and where there are no preferred directions—that is, in a universe where the 'cosmological principle' holds—it can be shown that such uniform expansion (or contraction) is the only permitted large-scale motion. The cosmological principle is justified both philosophically and empirically: the former in the neo-Copernican sense that we must assume that we are in no way singled out as special observers of the cosmos; and the latter in that galaxy counts and the isotropy of the cosmic background radiation suggest that the Universe is indeed homogeneous and isotropic on sufficiently large scales. There are other reasons for the faith of astronomers in the expansion hypothesis: the expansion is associated with a characteristic time (which may naively be thought of as the time since the Universe was in a state of infinite density) which is closely comparable with the ages

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of the oldest known stars; and the discovery of the predicted cosmic microwave background strongly suggests that the Universe has evolved from a hotter dense state. Moreover, the Hubble expansion finds a natural theoretical framework— that of Einsteinian General Relativity—which in fact predates the discovery of the expansion and which has been amply confirmed in the limited tests possible to date.

Deviations from the simple Hubble law have in fact been noted in the past, Hubble himself recognised a degree of nonlinearity in his data and concluded that the gravitational deceleration of the expansion was the cause. Vaucouleurs interpreted similar findings in terms of local departures from the Hubble flow caused by the existence of a Local Supercluster of galaxies. Other anisotropic features in the flow, the so-called Rubin-Ford effect, have received various suggested explanations. The lesson to be drawn is that the purely astronomical interpretation of such effects is not at all clearcut, even in the simplifying context of a general underlying expansion.

Statistical tests must obviate these problems by the careful definition of completely unbiased samples unaffected by subtle selection effects. The difficulty of the exercise is reflected in the fact that R. M. Soneira, in a careful statistical reworking of Segal's earlier analysis, found no disagreement with the expansion hypothesis but felt able to exclude the correctness of the chronometric prediction at better than the 99,999 per cent formal confidence level. However, Soneira's analysis has in turn been criticized by Segal and by Nicoll and Segal, who reach the opposite conclusion at comparable confidence levels. Their latest papers represent the most exhaustive statistical analysis to date, with the authors concluding that..."the Hubble law lacks an objective statistical foundation".

The validity of this conclusion and the resolution of the questions raised about our understanding of the large-scale structure of the cosmos may come in further statistical analyses which confirm or deny the various treatments. It may be that considerably more observational data and careful mapping of local anisotropic effects will prove essential. If the suggested nonlinearities are found to exist, most astronomers will seek explanations in terms of local deviations from the Hubble flow rather than in the wholesale rejection of the presently believed cosmological description of the Universe, with its history of successful predictions and supportive tests. The onus is upon the advocates of alternative theories to demonstrate the absolute insufficiency of any such explanations.

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The expanding science of photobiology

by John J. Giger

(Extracts)

Photobiology is concerned with the vast range of actions of nonionizing radiations on biological systems—from photolysis of simple molecules in pure solution to the effects of sunlight on human skin and problems of world food production through photosynthesis. ...

chain controlling cyclic GMP levels. There is evidence that the site of interaction of rhodopsin with membrane enzymes

Reversible photochemical reactions are often used by biological systems to sense changes in the environment. The most obvious and certainly the most sophisticated such system involves the protein rhodopsin pigments used in animal vision. Photoisomerization of the retinal prosthetic group of rhodopsin leads to an alteration of the receptor cell membrane potential, but the intermediate steps are not understood. Since the cell membrane is not connected to the disks that contain the rhodopsin, there must be a diffusible transmitter, and this is now believed to be cyclic GMP, rather than the previously proposed calcium ion (M. Chabre, Grenoble). It is proposed that rhodopsin floats in a fluid membrane and, on photoexcitation, interacts with an enzyme/ is remote from the retinal itself, which implies that there is an overall conformational change of the whole rhodopsin molecule. Support for this picture comes from the findings of H. Shichi and R.L. Somers (National Eye Institute) that purified rhodopsin illuminated in vitro activates a purified GTPase; this results from formation of a protein-rhodopsin complex and does not require a membrane environment.

Another important reversible photoreaction used by biological systems for sensory purposes is the phytochrome system of plants. H. Smith (University of Leicester) discussed the role of phytochrome in the natural environment. Light penetrating a plant canopy is enriched in far-red wavelengths (700-750nm), because of absorption of other wavelengths by chlorophyll. This alters the phytochrome photoequilibrium, thus permitting the plant to detect the amount of canopy shade, and to react accordingly—either by growth out of the shaded area or by changing leaf and chloroplast development and metabolism to adapt to the shade regime. However, it is still not clear whether this detection depends on the ratio of the red and far-red forms of phytochrome or on the amount of the far-red form present.

Bioluminescence assays were described by A.M. Michelson (Institut de Biologie Physico-Chimique, Paris), based upon the

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fact that clam luciferases behave like peroxidases, producing superoxide radical anion, which then causes the clam luciferin to luminesce. ...

In the area of basic mechanisms in ultraviolet photobiology progress has been made in the study of lethal effects of near-UV radiation (300-380nm), which is present in sunlight at the surface of the Earth. ...

Photomedicine was much in evidence reflecting a maturation of photobiology in its application to medical problems. Of great interest were developments in so-called PUVA therapy, which involves the treatment of skin lesions, such as psoriasis, by administering the dye Psoralen (orally) and then irradiating with UV-A light (near-UV light in the range 320-380nm). This therapy has been extremely effective in producing clearance and remissions. Unfortunately, there is concern that long term PUVA may act as a promoter of nonmelanoma skin cancer, although this hazard has not prevented some 80,000 patients in all parts of the world from utilizing the therapy because the disease itself is so disfiguring. ...

A second area of great medical interest concerns the immunological rejection of UV-induced skin cancers, studied by M.L. Kripke and co-workers (Frederick Cancer Research Center, Maryland). Many UV-induced squamous carcinomas and fibrosarcomas are immunologically rejected when transplanted to normal syngeneic recipients, but grow progressively in immunologically deficient animals or animals that have been UV irradiated (including the animals in which they were originally produced). Kripke and co-workers have found that antigens produced during UV irradiation of the skin trigger the production of suppressor lymphocytes, which in turn prevent an immunological rejection of the tumour. Langerhans cells (macrophage-like cells in the skin) may be involved in the initial events in this process. K. Wolff (Innsbruck University) pointed out that Langerhans cells show the highest susceptibility to UV damage of all skin cells, and that UV abolishes their immunological surface markers and abrogates their capacity to stimulate T-lymphocyte proliferation. E.C. DeFabo and F.P. Noonan (Kripke's group) have found that the wavelength maximum for depression of contact sensitivity in mouse skin is at about 270 nm, which may reflect absorption by urocanic acid, a metabolite of histidine, which accumulates in the skin where it cannot be further metabolized. Urocanic acid, incidentally, has been proposed by J.A. Parrish (Massachusetts General Hospital) to act as a natural photoprotection (light-screening) agent, which is partially removed when skin is washed, explaining an observation first made by Jacopo Beccari in 1744 that his hands fluoresced

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better in sunlight after being washed....

Photobiology has become a very active discipline that is now rapidly maturing. Sophisticated physical and chemical techniques are being applied, and significant advances in fundamental knowledge are being made. It is playing an increasingly important role in medicine. All this comes as no surprise to the photobiologists, who share the view of Isaac Asimov that "The Earth is bathed in light from the Sun, and one could scarcely think of a more important single fact than that".

(Nature, 289, 5799 (February 19, 1981) pp 636-637)

* Victories for Radiation Therapy *

* Lawrence Galton in Parade *

* 1 Mar. 81, p. 10 *

* ..."Of patients with Hodgkin's disease, a lymph-system cancer that was once 75% fatal, 80% of radiotherapy patients are surviving for five years and more. Cancer of the larynx, if detected early (as it is in more than 50% of all cases), often can be treated with radiotherapy. The cure rate: more than 90% — with preservation of the vocal cords. Cancer of the testicles, when still localized, as it often is, has a cure rate of less than 50% when treated with surgery alone. But with surgery and radiotherapy, the five-year survival rate exceeds 90%. Retinoblastoma, a tumor of the retina, also is responding to radiotherapy. Of 20 radiotherapy patients with the eye disease, 17 have had a five-year cure—with preservation of eye and vision." These and other results were reported in late 1980 at the American College of Radiology Conference in New York City. *

* (Source: Current Contents — Phy. Chem. & Earth Sciences, 21, 16 (April 20, 1981) p 13) *

Quasars: what and where?

by Martin Ward

(Extracts)

Recently the Royal Astronomical Society was host to a discussion meeting on Quasars which, although short, did provide an insight into the astronomical communities' current views on the nature of quasars. The talks appeared to divide naturally into two categories--concerning what quasars are and concerning where they are.

The latter question relies heavily on statistical arguments, often a weak point amongst astronomers. A study of pairs of quasars with very similar redshifts shows that, assuming the redshift is a result of the expansion of the Universe, their projected separations in space are between 5 and 30 million parsecs. As clusters of galaxies are thought to be components of 'superclusters' with dimensions of comparable range the observations may suggest that quasars are in superclusters too faint to be seen. ...

The continuum radiation from a large number of quasars has now been observed from X-ray to radio frequencies. Variations in the intensity of this radiation over short timescales, in many cases days, strongly suggests an origin in the very central regions of the object. If quasars are assumed to be at great distances it is difficult to see what sort of powerhouse is capable of generating these enormous energies. A general picture which has gained acceptance over the last few years requires the presence, at the center of quasars and related objects, of a supermassive object (black hole) equivalent to something like 10^8 to 10^{10} solar masses. Material, possibly debris from stars torn apart by tidal forces, then falls onto the central object releasing energy as it does so. There is good evidence for a similar, although very much scaled down, version of this process operating in close binary star systems in our galaxy. But at the centre of quasars things are likely to be less simple, the infall of material will probably be more chaotic for example. Before the radiation generated deep down at the centres of quasars is detected by our instruments it will have interacted, that is been scattering absorbed and re-emitted, by material within the quasar. These effects modify the observed continuum spectrum so a simple power law fit that might arise from synchrotron radiation does not usually provide good agreement with the observations. The multifrequency observations now possible using satellites and ground based telescopes have proved very useful, and the various lumps and bumps by which their spectra deviate from a smooth distribution are now the subject of much research. ...

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A consensus seems to have been reached on a basic model of the line spectra of quasars, both emission and absorption, although it should be borne in mind that the following numbers are order of magnitude at best. In a typical quasar the emission lines arise in a region about 1 parsec in diameter and this volume contains about 100 solar masses of ionized gas. The distribution of the gas is far from uniform and consists of a large number of dense clouds (perhaps 10^{12} of density 10^9 particles per c.c.). These clouds may not be fully ionized and could contain an unknown amount of neutral gas. The cloud model provides a simple approximation and no information is available on the shapes and distribution around the nucleus. It seems that the dominant source of ionization is from the central source and not from collisions between the clouds, although this process is known to produce the emission lines in some nearby active galaxies. One important and recently recognized feature of the ionization process is the role played by soft X-rays which penetrate deep into the gas clouds. By considering this effect there is better agreement between the observed and the theoretically predicted emission line ratios. There is disagreement over whether obscuration by dust is important. This effect reduces the intensity of short wavelength emission lines relative to longer wavelength ones. It is certainly true in galaxies that where there's gas there's dust, but the relative amounts in quasar emission line clouds is at present unknown.

Finally the absorption line problem. It has been known for some time that the broad emission line Lyman alpha often has, superimposed on its profile, numerous narrow absorption lines which are usually blue-shifted with respect to the quasar. This is the so-called Lyman alpha 'forest'. The question is, do these absorptions arise in material near to the quasar or elsewhere along the long line of sight between us and it? Opinion now favours the latter interpretation. An explanation in which the absorption occurs in the halos of galaxies is an interesting possibility. If this is correct we could use the light from background quasars to study the properties and statistics of galaxies far too distant to be detected by their own feeble light.

It would be wrong to give the impression that a revolution has taken place in our knowledge of what quasars are over the last few years, but neither is pessimism justified. The new multi-frequency continua and high resolution spectral line observations, together with variation studies have improved our understanding. Progress is being made.

The blow that gave birth to Iceland?

The idea that a giant meteor struck the Earth some 65 million years ago, causing environmental changes which brought an end to the age of the dinosaurs, has gained some currency recently (New Scientist, vol 85, p 59). Now, Fred Whipple, of the Smithsonian Astrophysical Observatory in Cambridge-Massachusetts, has suggested that the scar left by the impact may still be visible - in the form of Iceland.

In a report from the observatory's Center for Astrophysics, Whipple describes the idea as a "speculation", but argues a plausible case. Evidence for the giant meteor impact at the time of the geological boundary between the Cretaceous and Tertiary eras comes from measurements of enhanced trace concentrations of iridium in sediments 65 million years old. The increase over "normal" levels is 160 times for sites in Denmark, 30 times in Italy and 20 times in New Zealand, suggesting that the impact occurred at high northern latitudes. But no scar of the right size and age can be found on land: the meteor must have struck in the Atlantic Ocean to account for the distribution.

Iceland is a unique example of a land mass lying astride one of the spreading ridges from which oceanic crust grows and pushes outwards. It is built almost entirely of volcanic rock, none older than the early Tertiary, and clearly began to grow just after the Cretaceous Tertiary boundary. Whipple speculates that the impact of a 10-km diameter meteor, producing a 100-km wide hole in the thin oceanic crust, could have allowed magma to well up on such a scale that the solidifying lava built up above the ocean surface, forming the growing island of Iceland.

The chance of a meteor striking close by an oceanic spreading ridge is about 4 per cent, says Whipple, so that the coincidence is not outrageous, although statistics mean little when dealing with a unique event.

(New Scientist, 89, 1245 (March 19, 1981) p 740)

Computers and the Biologist

Among biologists, physiologists have inevitably taken most readily to the use of computers; people brought up to know the difference between d.c. and a.c. amplifiers are naturally more inclined to give house-room in their laboratories to further electronic equipment. Yet the past few years have seen the infiltration by computers of most other kinds of research laboratories.

In all kinds of laboratories, the chief use of computers is still in the storage and analysis of data. The principles are as old as computers themselves. Data are digitized, stored within the accessible part of the computer or dumped onto magnetic tape, and analysed by whatever computer program is appropriate. In the 1960s, most large biological laboratories found it expedient to install substantial main-frame computers to provide their members with a data-processing service. Now, however, with the arrival of mini-computers and microprocessors, the trend is towards distributed computer capacity. Individual laboratories are acquiring their own mini-computers, while many pieces of equipment are now designed to operate with their own built-in microprocessors. (Most manufacturers of substantial pieces of equipment, for radio-immunoassay, for example, now provide floppy disks which allow the users to play games such as Star Wars as well as the more sober programs required to analyse the data, no doubt from compassion for those working in laboratories with time on their hands.)

This trend is probably inevitable, and unstoppable. For the user, the obvious advantage is to be fully independent, able to process one's data whenever necessary. Central machinery working on a batch-processing basis is necessarily by comparison an encumbrance. And there has grown up a certain air of disenchantment, at least among biologists and biochemists, with computer systems designed to be accessible by means of computer terminals in the laboratory.

Nevertheless, some of those concerned with the provision of computing facilities in general purpose laboratories are uneasy. Although the new small computers and microprocessors are cheap, the software required for specific specialized function may make serious demands of programming skills. The end result, some gloomy calculations suggest, may be that the central cost to laboratories may be greater than at present. The alternative, that individual researchers should themselves become skilled at programming their own machines, is regarded with apprehension.

Laboratory administrators are also uneasy about the cost of

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measuring equipment with built-in microprocessors. The convenience and efficiency of these machines is beyond dispute. The suspicion is merely that the value added by the manufacturers of the equipment may not give the user a fair share in the cost benefits of the cheaper hardware now available.

The truth is probably that laboratory administrators are learning a painful lesson in economics. The development cost of software for a commercial measuring instrument is likely to be greater than that of writing a program in a particular laboratory. But the manufacturers of the measuring instruments with built-in microprocessors also find that demand is buoyant, suggesting that people able to afford the new equipment are prepared to pay for its convenience.

There are several well-attested illustrations of the costs that can be saved by home-made equipment. Thus one West Coast neuro-physiologist, unable to afford from his current grant the \$ 20,000 to buy a suitable wave-form analyser, reckons that he was able to produce a better system for a quarter of the cost and at the same time produce a system of analysis better suited to his needs. The underlying dilemma is familiar -- to what extent should research laboratories spend their time and energy on the construction of instruments which are nevertheless obtainable commercially.

Not all of the tasks of the general biological laboratory have as yet been delegated to the instrument manufacturers, however. Indeed, even in some of the most familiar tasks, the analysis of electrical output from physiological preparations for example, formidable intellectual difficulties keep cropping up.

The standard record in such experiments consists of a voltage (or several voltages) varying with time, on a time scale of milliseconds or thereabouts. Given a visual trace of such a voltage, it is possible with a ruler to estimate parameters such as the peak voltage, the time taken to reach that voltage and so on. Computer systems store the same information in digital form, and there are constant (if groundless) worries about the extent to which such data embodies "everything". More seriously, physiologists are likely to insist that some form of visual record should be obtained in parallel with whatever computerized analysis is found convenient. Machines may be able to analyse complicated sets of data once they have been provided with criteria for setting about this task, but cannot recognize novel kinds of patterns.

So much is evident in the difficulties which keep cropping up in the research programmes intended to provide more sophisticated

monitoring of the physiological condition of hospital patients, people in intensive care units for example. Many of the systems developed for this purpose depend on the recognition of abnormal trends in, for example, heart-beat rate, or variation from one cycle to another. One difficulty is that too little is known about the statistical properties of normal heart-beats to provide a sure yardstick for abnormality. The result is that false warnings abound, while few are confident that the systems now in use are capable of recognizing more than a small proportion of impending crises.

But what of the application of computers to tasks in biological research that have hitherto been beyond the scope of conventional techniques?

Many of the innovations in the past few years are comparable with those in other fields. It is unthinkable that X-ray diffraction data should, these days, be analysed by the traditional methods, and computer techniques are used as a matter of routine in construction of the models of most molecules, biological or otherwise. Quite apart from the way in which computing machinery has given people the courage to tackle problems that would otherwise have been neglected, the more economical use of data has made it possible to work with lower X-ray intensities.

Another development of this kind is in the construction of molecular models. Modelling biological molecules of any complexity is a formidable task, and this is the principal incentive for the development in the past decade or so of computer programs which can handle such tasks quickly but, more important, can in principle explore all possible configurations of a complicated molecule.

These are essentially data-handling tasks. The most recent development of this kind has been prompted by the sheer size of the nucleotide sequences now being accumulated. It is natural that these should be stored in computer form, and plans for the development of such a computer bank have been discussed between the National Institute of Health in the United States and the European Molecular Biology Organization. One obvious elaboration of such a system is the use of computer programs for searching nucleotide sequences for particular configurations of nucleotides, for example for configurations that define the points of action of particular restriction enzymes. But the construction of a complete nucleotide sequence is not always straightforward, given that it may have to be inferred from the nucleotide sequences of overlapping fragments of a complete DNA molecule, which is why there are now ambitions to solve such essentially combinatorial problems by using computing machinery.

(Nature, 290, 5803(March 19, 1981) p 194)

Astrophysics and particle physics come together

by Frank E. Close

(Extracts)

The advances made in high-energy physics and astrophysics have enabled the 1970s to be described as the greatest ever in fundamental research. The discoveries of the J/ψ particle in 1974 and of charm in 1976 provided major evidence supporting the theory that united the electromagnetic and weak forces. Some of these particles' properties caused attention to be focused on a candidate theory of quark interaction, named 'quantum chromodynamics' or simply QCD. (The so-called 'strong' nuclear force is now viewed as a complicated manifestation of this more fundamental QCD force which acts on the quarks — the constituents of the subnuclear particles.) Although still some way from being verified, accumulating data do appear to fit in with theoretical expectations based on QCD.

The mathematical similarities among the theories of the electromagnetic, weak and 'strong' forces are so striking that theorists have tried to build a grand unifying theory which would include all the natural forces except gravity. The simplest way of implementing the theory has already successfully predicted the existence and mass of the fifth variety of quark (the so-called 'bottom' quark). Much experimental effort is now centred on the prediction that protons are unstable. ...

Proton stability is particularly significant as several years ago Andrei Sakharov (Gorki) had noted that three ingredients were required if we were to understand the apparent excess of matter over antimatter in the Universe at large. One is an absolute distinction between them; this is indeed provided in nature by the phenomenon of CP violation (whose discovery led to the 1980 Nobel prize for Cronin and Fitch of the US). The second is an absence of thermal equilibrium: provided in modern cosmology theory by the big bang expansion. Finally, proton instability is required. This is indeed provided by the grand unified theories; we wait to see if it is also provided by nature.

Within the grand unified theories it has been argued that mechanisms naturally exist that will give rise to the observed quantitative matter excess. Ellis pointed out that the validity of this 'explanation' can be tested because the mechanism also generates an electric dipole moment for the neutron. At present there is an experimental upper limit that places this moment at less than about 10^{-24} e cm. Present experiments hope to lower this by three orders of magnitude. Ellis noted that the above theories provide a 'cosmological lower bound' some four orders of magnitude below the present limit. This should provide a significant spur to

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experiment and provides another example of how studies of subnuclear particles can reveal the mechanisms responsible for the development of the early Universe.

One of the more recent lines of investigation is into the question of whether there are new phenomena between the present energies and 10^{15} GeV (apart from the predicted production of massive W, Z particles of the electroweak theory and the postulated sixth quark and Higgs particles). In particular, the nature of the Higgs particles is unclear.

During the past year there has been much interest in the possibility that the Higgs particles are not elementary but are dynamically bound composite systems of more fundamental entities. E. Eichten (Harvard) described so-called 'hypercolour' or 'technicolour' theories that contain the Higgs particles as composite bound states and in some formulations require substructure to the leptons and quarks. These theories predict that a new ultra high-energy scale of phenomena exists in nature. Eichten described possibilities of testing these ideas at present energies. Experimentalists are urged to search for the light pseudo-Goldstone bosons predicted in the theory (possibly of a mass of about 10-20 GeV and producible in electron-positron annihilations.) or to search for the rare decay modes that technicolour's existence can induce from the conventional particles (like $\mu \rightarrow e \gamma$, $\bar{K} \rightarrow \mu e$).

Finally, in all these brave schemes to unify our understanding we come up against the perennial problem—gravity. How gravity fits into nature's scheme is still something of a mystery. P. van Nieuwenhuizen (Stony Brook, US), one of the founders of 'supergravity' theory, described developments in this exciting field. Some of the technical problems that arise attempts to build a satisfactory quantum theory of gravity appear to be overcome if gravity is but part of a larger theory—supergravity. This theory is very elegant mathematically and yet, frustratingly, we have little or no indication that Nature has made use of it. van Nieuwenhuizen succinctly summarized the beauty of the mathematical structures by saying "I hope that Nature is aware of our efforts".

(Nature, 290, 5801 (March 5, 1981) pp 12-13)

The APS Annual Plasma Physics Meeting
Some Inertial Confinement History Declassified
(Extracts)

More than 2,000 fusion scientists, engineers, and industry representatives from around the world attended the 22nd Annual Meeting of the Division of Plasma Physics of the American Physical Society in San Diego Nov. 10-14.

Some of the current developments that were reported are: Dr. G. Grieger of the West German Max Planck Institute reviewed the current status of the donut-shaped magnetic bottle known as the stellarator, a U.S.-developed concept that preceded the Soviet-conceived tokamak. The PDX tokamak at the Princeton Plasma Physics Laboratory continues to achieve good results. The magnetic field geometry of this poloidal divertor device permits the removal of plasma impurities. Confinement of the plasma in the PDX is comparable with the best results attained in the Princeton PLT tokamak. The ISX-B tokamak high-beta experiments at Oak Ridge National Laboratory were reviewed and analyzed by Dr. D.J. Sigmar. Although further experiments are needed to confirm the ISX results, there is strong evidence that the ISX has already exceeded the theoretical stability limits for containing high-beta plasmas without the observation of any instability. This is a very promising result since high betas mean that the confining magnetic fields are more efficiently utilized.

New proposals for using "exploding" wires -- wires through which a large electrical current is passed -- for a combined magnetic and inertial-fusion system were presented.

New designs for technologically more simple tokamak reactors were presented by Dr. Dan Jassby of Princeton.

The latest, encouraging results on the IMX, the Tandem Mirror Experiment at Lawrence Livermore National Laboratory, were presented at the detailed in a number of talks.

Sandia National Laboratory reports bringing its Particle Beam Accelerator Facility 1 up to outputs of 1 million joules.

Dr. Winston Bostick and his colleagues at the Stevens Institute of Technology in New Jersey reported their detailed experimental findings showing that electron beams form into vortex structures. This work could be quite crucial for beam propagation.

In his invited talk to the APS meeting on the "Physics Requirements for High Gain", Dr. Stephen Bodner of the Naval Research Laboratory's laser fusion program in Washington; D.C. revealed for the first time that Lawrence Livermore is using the idea that Rudakov made public in 1976—the conversion of laser light to soft X-rays in high-density target designs. This revelation comes as a result of the limited declassification of the work by the Department of Energy after the 1979 Progressive Magazine court case. As a result of the information discussed at the San Diego meeting, Fusion is now able to report for the first time on the actual History of inertial fusion since 1950.

In the early history of inertial-confinement fusion, U.S. scientists believed that to be economically competitive, very simple, unclassified fusion fuel targets, consisting of a spherical drop of frozen hydrogen (D-T), would have to be used. Therefore, U.S. researchers concentrated on beams with high power fluxes, greater than 10^{14} watts per square centimeter. If these simple targets proved incapable of achieving high energy gains—gain equals fusion energy output divided by beam energy input—then provision was made for developing hollow spherical targets that were capable of being imploded with lower beam power inputs.

The Soviet inertial fusion scientists argued from the early 1970s on that beam-plasma instabilities would limit beam power fluxes to below 10^{14} watts per square centimeter and that, therefore, very thin-shelled targets would be needed for high fusion energy gains.

(Fusion, 4, 5& 6 (March/April 1981) pp 12-13)

Antibodies, introns and biosynthetic versatility

by Miranda Robertson and Mike Hobart

(Extracts)

Soon after the discovery that eukaryotic genes may be interrupted by non-coding DNA sequences, Gilbert speculated in Nature that this unexpected arrangement might make it possible to produce variants of a single protein by differential splicing of the interrupted RNA. Specifically, he suggested that such a mechanism might underlie the well defined sequential changes that take place in the immunoglobulin molecule in the course of B lymphocyte ontogeny. As a result of these changes, a single antigen-binding site is associated successively with different effector sites to produce first immunoglobulin M, then immunoglobulin D, and later immunoglobulin G or sometimes A or E. Each of the different classes of immunoglobulin is expressed first as a membrane-bound receptor molecule and later, on the terminal differentiation of the lymphocyte, as a secreted protein which is identical to the receptor in all but a few residues at its carboxy terminal.

Both the class of the immunoglobulin molecule and whether it is membrane-bound or secreted depend on the structure of the constant region of its heavy chains. Thus each heavy-chain variable region (V_H region) is associated in turn with a constant region (C_H region) coding for the $\mu, \delta, \gamma, \alpha$ or ϵ chains corresponding to IgM, IgD, IgG, IgA and IgE; and each of these chains may then undergo modification at its C end. It is now known that the class switch from IgM to IgG, IgA or IgE is mediated by translocation of the V_H region DNA with deletion of the C_H regions 5 to the one that is expressed. Deletion, however, cannot explain the switch from IgM to IgD, because some B cells, including a few tumour cell lines, synthesize IgM and IgD at the same time; nor is it an attractive explanation for the switch from membrane to secreted proteins which are also simultaneously expressed. Instead, as Gilbert surmised, these processes are controlled by processing of the RNA....

The second question is that of the mechanism by which introns are eliminated from nuclear RNA. Until now, the simplest scheme — that the splice site at the end of each exon is paired with the matching sequence at the beginning of the next one downstream — has also been consistent with the known data. However, it plainly cannot account for the removal of the μ exons from the large $\mu - \delta$

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transcript. There is still a formal possibility that such a combined transcript does not exist; but if it does, it will clearly represent a further strong incentive to molecular geneticists of immunoglobulin to devise a splicing system that will work in vitro.

(Nature, 290, 5807 (April 16, 1981) pp 543-544)

*
* The Gene Craze *
* Rae Goodell (Massachusetts Institute of Technology *
* in Columbia Journalism Review 19(4):41-5, Nov-Dec 80 *
*
* ... "Genetic engineering has become a media celebration, *
* a rags-to-riches story of the burgeoning biotechnology *
* industry, capitalizing on the titillating theme of the *
* merger of 'life' and big business....Based on potential *
* rather than actual products, the fledgling genetic in- *
* dustry has needed carefully timed and orchestrated pro- *
* motion, and the press has provided it. Hardly, a week *
* goes by without an enthusiastic announcement in the *
* daily press of a new discovery, new company, new contract, *
* new application....Between hypothetical benefits and *
* imaginary monsters, there seems to be no room in most *
* recombinant DNA coverage for questions of occupational *
* hazards, environmental impact, public regulation. *
* Although by no means all reporters take this Pollyanna *
* approach, the general effect is anachronistic, a throw- *
* back to the gee-whiz, sciences-saves 1960s before *
* the press learned that technological advances have *
* side effects. The nuclear industry may have its Three *
* Mile Islands, and the chemical industry its Love Canals, *
* but the genetics industry is somehow different, fool- *
* proof." *
*
* (Source: Current Contents - Life Sciences, *
* 24, 10 (March 9, 1981) p 12) *
*

Motorway pollution provides insects with nitrogen feast

Plants surviving near motoways gorge themselves on nitrogen pollution, making them vulnerable to savage attacks by herbivorous insects, according to ecologists at Imperial College's research station at Silwood Park, Ascot (Journal of Applied Ecology, Vol 17, p. 649).

Motorway verges and central verges are usually thought of as hostile environments for animals and plants alike. Exhaust fumes, rubber particles, lead, gusts of wind from passing traffic and de-icing salt are an oppressive combination for most organisms to tolerate. Yet despite this, many herbivorous insects seem to thrive on the motoway vegetation for no apparent reason. The result has been hedges and trees stripped of leaves, not only in this country but also in California and Switzerland where infestations are particularly noticeable on central reservations.

Gordon Port and Jim Thomson surveyed populations of moth larvae feeding on hawthorn bushes--the buff tip moth (*Phalera bucephala*) by the A423(M) road and the gold tail moth (*Euproctis similis*) by the M63 motorway. Both species of larvae are ferocious feeders on the foliage of a wide variety of trees and shrubs, but normally their larval populations are kept in check by birds, wasps and many other predators. Perhaps, then, a lack of predators on the motorways leaves the larvae unharmed. Not so say Port and Thomson. Although birds could not withstand the motorway maelstrom, to their great surprise they found that species of the wasp *Paraverpula* could. But so many larvae fed on vegetation in the central reservation (in particular) that the wasp predators made little impact on the larval populations.

To find out what did cause the flourishing of the moth larvae. Port and Thomson studied the levels of pollutants in plants taken from the motorways and their immediate vicinities. Lead, sodium and nitrogen all occurred in uncommonly high concentrations, especially on the central reservations. But another surprise was the level of soluble nitrogen in the plants was nothing extraordinary. They suggested instead that the main increase in nitrogen was due to the high levels of airborne nitrogen oxides (NO_1). Other workers have reported an increase in amino acid levels in plants growing by roadside verges, and Port and Thomson suggest that this may be due to the plants absorbing the NO_1 pollution through their leaves.

The increase in nitrogen not only boosts their growth, it also makes them more appetising to the herbivores. Lack of nitrogen

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is often a limiting factor in the growth and development of insect larvae, but when the shortage is overcome their populations can explode. On motorways the larvae gobble up an abundant supply of nitrogen from the plants, so that in an indirect way exhaust fumes benefit herbivorous insects.

The larvae also profit from another motoway pollutant. The de-icing salt applied to road surfaces reaches central reservations and verges mostly as spray. The resulting downpour of sodium is an additional boost for the larvae.

(New Scientist, 89, 1246 (March 26, 1981) p 806)

* The Growth Industry
* Bob Tamarkin in Forbes
* 127(5):90-4, 2 Mar 81
*

* ...'Genetics not only yields crop increases, it
* gains time. Nobel peace prize winner Norman
* Borlaug took 20 years using crossbreeding tech-
* niques to develop the resistant strains of rice
* and wheat that produced the Green Revolution in
* India and Pakistan. Genetic engineers would cut
* those decades to a matter of months if they could
* master the art of separating and perpetuating
* healthy genetic characteristics. And the work
* has begun. Mary-Dell Chilton (Washington Univ.,
* St. Louis) is trying to insert the soybean's
* protein-transforming gene into tobacco, the most
* common laboratory research plant. If it works,
* the gene-transfer techniques could be applied
* to food plants. Researchers at Univ. California,
* Davis, are concentrating on improving photo-
* synthesis....If the process could be made more
* efficient, plants would grow faster....Stanford
* Univ.'s Ronald W. Davis is researching ways to
* alter corn's protein-storage genes to make that
* \$50 billion crop more nutritious. At Kansas
* State Univ., plant pathologist James Shepherd
* is cloning potato plants resistant to blight."

(Current Contents - Life Sciences, 24, 14
(April 6, 1981) p 8)

* * * * *

Environment forces plants to change sex

Most species of plants are hermaphrodites—they have both male and female reproductive organs in the same flower. Hermaphrodite plants can vary their sex by increasing or decreasing the amount of energy they devote to producing pollen (male gametes) or seeds (female gametes). In a substantial minority of plant species the sexes are separated into different male and female individuals, as in most animals. Species with separate sexes are called dioecious species. Biologists have usually thought that the sex of an individual of a dioecious species is fixed by its genotype: individuals with one genotype become males, those with another become females. But D.C. Freeman, K.T. Harper and E. Charnov have come to a different conclusion after reading the published papers of the past 70 years or so (*Oecologia*, vol 47, p 222). They have found over 50 dioecious species that can change sex. Asparagus officinalis, the species with the tasty tender young shoots, is one example.

Sex changes seem to be caused by factors in the environment; for example light intensity, soil moisture and nutrient content, day length, injury and disease of the plant itself. Some of these move plants to maleness, others to femaleness. One clear generalisation is "a strong tendency for environmental stress to induce maleness". The dioecious spinach Spinacia oleracea changes from female to male in high temperatures, for example. The hermaphrodite oaks, maples, junipers and wheat all tend to become more male in dry soil. These experimental results fit with the distribution of the sexes seen in nature. "Males are more commonly encountered in harsh environments, while females are most often found in favourable sites", the researchers say.

The plant's hormonal system ensures that it has a sex appropriate to its environment. Changes in the environment, plant physiologists have found, cause changes in the concentrations of hormones circulating in the plant. And experimental changes in the amounts of particular hormones in a plant cause changes in the plant's sex. For example, plants suffering from a shortage of water increase the amount of hormones called cytokinins, which, among other things, cause the plant to become more male.

Natural selection would favour plants that can change sex if the plant can reproduce better as a male in one kind of environment but as a female in another. One theory is that a female plant would do better in wet surroundings because it needs more water to produce seeds than a male does to produce pollen.

How Plants can "talk"-electrically

In an arid valley near Tucson, Arizona, an electrical engineer has wired up a remote sensing system to eavesdrop on crops. Sitting in his air-conditioned University of Arizona Office, Dr. William Gensler monitors electrical signals generated by plants growing 35 miles away.

These signals are produced when a plant converts nutrients and sunlight into new plant materials. Gensler believes that by deciphering the signal patterns he will be able to monitor every stage of a plant's development - from sprout to harvest - without having to set foot in the fields. Gensler would like to wire the plant world into the global communications network. "There is no reason why a plant's electrical signals can't be transmitted over hundreds, even thousands, of miles by satellite", he says. "On any given day I'd like the people on the Board of Trade in Chicago to be able to tell how the corn is doing in Iowa".

The signals he picks up occur during photosynthesis, when chlorophyll converts solar energy into electrical energy that is transported throughout the plant in the form of electrons. The presence or absence of these electrons creates an electrical potential that Gensler can measure.

To do this, he implants thin palladium electrodes in individual plants. The electrodes are wired to a central control box in the field that contains a microcomputer. Readings of plant signals and surrounding environmental conditions are taken every 15 minutes, 24 hours a day, and are radioed to his office.

Gensler is trying to correlate voltage patterns with changes in plant physiology. So far, he has detected a definite electrical reaction to irrigation. "And there are preliminary indications", he says, "that I can tell from the signals when cotton is ready for harvest".

(Science Digest, 89,1 (January-February, 1981) p 36)

Interferon business - Trials ahead

by Peter Newmark

(Extracts)

Many of these companies already had a declared interest in interferon but some were new to the game. ICI let it be known that it has cloned an interferon gene from lymphoblastoid cells in collaboration with Dr. E. de Maeyer's group at the Institut Curie in Orsay. ICI says that this is just an exercise in cloning, but with the setback in the fortunes of the company earlier in the year (Nature 12 March), there must be thoughts of trying to cash in on clones.

There is little doubt that the demand for highly purified interferon is growing, but the growth can be fitful. Wellcome, for example, recently claimed that supply had outstripped demand for its alpha-interferon (from white blood cells). That situation could easily be reversed if the current clinical trials of Wellcome's interferon show promise. The interim results, reported in Rotterdam, of several relatively large trials of a variety of different alpha-interferons suggest that it has a tantalizing degree of activity against a broad spectrum of viral diseases and tumours. But activity is not enough, or consistent enough, in most diseases to give a final verdict without more trials. Also, as genetically-manipulated bacteria start to yield sufficient amounts of the ten or so subtypes of alpha-interferon, the permutations of subtypes and diseases becomes huge.

Meanwhile, large-scale trials of beta-interferon (from fibroblasts) lag slightly behind. The largest has yet to start. Financed and organized by the National Institutes of Health (NIH), the trial will use 50,000 million units of beta-interferon, enough for several hundred patients. The interferon is being supplied by Flow Laboratories Inc., which won the \$2 million contract a year ago, but NIH appear to be in no hurry. This is lucky for Flow Laboratories, whose own production has not been going smoothly. Fortunately, they have a subcontract with the West Germany company of Dr. Rentschler Arzneimittel GmbH which has continued to amass beta-interferon made by its own, less advanced, techniques.

The next big contract, also for NIH, will be for gamma-interferon (from cells of the immune system). Far less is known, at least publicly, about this type of interferon, but Biogen and Genentech are rumoured to be on the verge of cloning the relevant genes.

Other commercial interests centre on monoclonal antibodies against the interferons. Several new monoclonals against either

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alpha or beta-interferons were announced in Rotterdam, but only the original monoclonal (see Nature 285, 446; 1980) is as yet commercially available. The sellers are the British company Celltech Limited, so far its only product. It will be surprising if the Celltech catalogue does not double soon.

(Nature, 290, 5809(April 30, 1981) pp 728-729)

* Nasal Spray Addicts *

* Richard Severo in New York Times *

* 3 Mar 81, p.C3 *

* ... "Doctors suspect that many thousands of people have *

* become physically dependent on nasal decongestant sprays *

* and that many are not even aware of their addiction or *

* that they can do anything about it....The physical *

* dependence on nasal spray is commonly called 'rebound *

* phenomenon', and there is enough of it that doctors *

* in the NY State Society of Otolaryngologists and *

* Maxillofacial Surgeons recently issued a medical advisory *

* about it. Some physicians regard the rebound phenomenon *

* as a kind of addiction, albeit markedly different than *

* the kind of addiction associated with drugs like heroin, *

* which give the user pleasure before the pain of with- *

* drawal. With nose spray abuse, the only 'pleasure' is *

* being able to breathe normally through the nose....Stuffy *

* noses occur when some stimulus causes blood vessels to *

* expand and become engorged with blood. When (deconges- *

* tants cause) the blood vessels to shrink, the stuffiness *

* goes away, at least temporarily....Physicians do not *

* entirely agree on what causes the rebound phenomenon, *

* but many of them feel that when the sprays are used too *

* often or for too long a period, the shrunken blood vessels *

* become fatigued, dilate and cause congestion to re-occur. *

* They can be made to dilate again, often when fatigued, but *

* more and more nasal spray is required to achieve the same *

* result." Steroids can break nasal spray addiction. *

* (Current Contents - Physical, Chemical and Earth *

* Sciences, 21, 16(April 20,,1981) p 13) *

Cystic fibrosis

— Diagnostic hopes

(Extracts)

Techniques now being developed at various centres in Britain and the United States have stimulated optimism about new approaches to the prevention of cystic fibrosis. Workers in the field are particularly excited by the prospect of being able to detect carriers of the genetic defect.

Among genetic deficiency diseases, cystic fibrosis is peculiar in that the nature of the underlying molecular defect is as yet unknown. The belief that only a single gene is involved has, however, recently been confirmed by Romeo (Bologna), working with records of dispensations for cousin-cousin marriages accumulated at the Vatican. Among Caucasian populations, the frequency of carriers of defective genes is thought to be 1 in 20. The Vatican records have confirmed that cystic fibrosis is an autosomal recessive disease, accounting for the normal incidence in Northern Europe of 1 in 1,600....

Genetic screening may well be possible before the nature of the underlying defect is understood. One possibility is that the protein characteristic of cystic fibrosis is in normal people removed by the proteolytic enzyme which is the basis of proposed diagnosis of the disease by amniocentesis. In Britain, Professor R. Williamson (St. Mary's Hospital Medical School) has embarked on a programme for the identification of the cystic fibrosis gene using techniques of chromosome sorting and genetic manipulation....

(Nature, 290, 5307 (April 16, 1981) pp 536-537)

Data Sought on Low Cholesterol and Cancer

by Gina Bari Kolata

Low cholesterol levels seem associated with cancer, but it is not yet clear how strong the association is or what it means

Accumulating evidence for a connection between low serum cholesterol concentrations and an increased risk of cancer has led researchers to pursue the question more vigorously, especially in light of other data that point to a clear relationship between high cholesterol levels and heart disease. Jeremiah Stamler of Northwestern University Medical School, who strongly supports cholesterol-lowering diets, says "there certainly seems to be something there but the relationship between low serum cholesterol and cancer is by no means clear, consistent, and unequivocal".

In an attempt to resolve the issue, the National Heart, Lung, and Blood Institute (NHLBI) contacted about 100 researchers who have been studying cholesterol and heart disease and asked them to reevaluate their data to see if they show an association between low cholesterol concentrations and cancer. Many of these investigators are expected to attend an NHLBI meeting in May.

As long as 10 years ago, evidence suggesting a low cholesterol-cancer connection was reported by M.L. Pearce and S. Dayton of Veterans Administration Hospital in Los Angeles, who noted an increased incidence of cancer in men on a cholesterol-lowering diet. But Frederick Ederer, now at the National Eye Institute, and his associates could not confirm this result when they looked at data from four similar studies.

About 5 years ago, Geoffrey Rose of the London School of Hygiene and Tropical Medicine accidentally came across a relation between low cholesterol and colon cancer. Rose hypothesized that colon cancer might be associated with high cholesterol concentrations, reasoning that the population with high rates of colon cancer were those with high rates of heart disease and high average cholesterol concentrations. He reviewed data from a number of large, prospective studies of heart disease and found, unexpectedly, that those who got colon cancer tended to be those whose cholesterol was low—less than 190 milligrams of cholesterol per 100 milli-

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liters of serum. The serum cholesterol concentration of the average American is 215 mg per 100 ml, and until recently it was 230 mg per 100 ml. Only 10 per cent of Americans have cholesterol concentrations below 190 mg per 100 ml.

But Rose's study was retrospective. One of the first prospective studies was that of Robert Beaglehole and his associates at the University of Auckland, New Zealand, who reported last year that in their 11-year study of 630 New Zealand Maoris, men and women with serum cholesterol concentrations below 190 mg per 100 ml had a higher rate of cancer. Similar results were then reported by Curtis Hames, director of the Cardiovascular Epidemiology Study in Claxton County, Georgia. Hames's group studied 3102 people for 12 to 14 years.

In the meantime, researchers with the Framingham study, a prospective NHLBI-supported study of 5200 residents of Framingham, Massachusetts, were looking at their data, which go back to 1948. Manning Feinleib, an NHLBI epidemiologist in charge of analyzing Framingham results says, "We found to our surprise and chagrin that people who were at the lowest end of the cholesterol spectrum had an increased cancer mortality". The association, however, held only for Framingham men, not women. It was especially strong for colon cancer but also held for all cancer combined. Men with cholesterol concentrations below 190 mg per 100 ml had three times the incidence of colon cancer of men with higher cholesterol concentrations.

Data from two other NHLBI prospective studies that involve only men—the Puerto Rico Heart Health Study and the Honolulu Heart Study—also show an association between low cholesterol and cancer. In Honolulu, the association was with stomach, colon, liver, and lung cancers. In Puerto Rico, it was with stomach and esophageal cancers.

However, four other prospective studies do not show any such association. These include the Chicago Peoples Gas Company Study and the Chicago Western Electric Company Study, with 15- and 17-year follow-ups, respectively. These studies included deaths from all types of cancer.

Two other groups have found an association between low blood cholesterol concentrations and cancer, but the association disappeared with time. Rose and M.J. Shipley

of the London School of Hygiene and Tropical Medicine followed nearly 18,000 men for $7\frac{1}{2}$ years. In the first 2 years of follow-up, but not subsequent years, those who had low cholesterol concentrations on entering the study had higher cancer death rates. This finding led Rose and Shipley to propose that the men who died of cancer in the first 2 years of the study may have had undetected cancer when they entered the study. This cancer may have caused their cholesterol concentration to drop. Thus the low cholesterol concentrations in those who died of cancer in the first 2 years may have been a manifestation of the cancer, not a cause.

F. Cambien and J. Richard of Equipe de Recherche de Cardiologie INSERM in Paris together with P. Ducimetiere of Unite 169. INSERM in Villejuif, France, came to a similar conclusion after noting that an association between low cholesterol and cancer in their population of 7603 middle-aged men disappeared after 7 years of follow-up.

About 1 year ago, the NHLBI held a conference to review the available data on low cholesterol and cancer. "We agreed that there is weak but suggestive evidence that low cholesterol may be in some way associated with cancer risk", NHLBI director Robert Levy says. "But the association still seemed inconsistent".

One reason why existing data are inadequate to determine whether there is a relation between low cholesterol and cancer is that heart disease is much more common than cancer. Therefore, even the largest of the studies of cholesterol and heart disease have relatively few cancer deaths. And when it comes to breaking down the data into cancers of specific types, there are even fewer deaths. It remains possible that low cholesterol may be associated with cancers in general, yet, says Stamler, "Everything we know about cancer tells us you must be very careful about treating all cancers as a group".

Several explanations have been considered for the association, if any, between low cholesterol and cancer. First is the possibility, raised by the French and British studies, that low cholesterol results from rather than causes, cancer. Levy is a bit doubtful of this, because if it were true, the Framingham cases would have had low cholesterol concentrations for more than 10 years before their cancers were detected. "It would be strange,

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although not impossible, for low cholesterol to be a marker for cancer so long ahead of time", he says.

It also may be that low cholesterol levels are linked to another factor that makes people susceptible to cancer. One possibility is that some people absorb less fat, and so absorb less of the fat-soluble vitamins, especially vitamin A. A deficiency in vitamin A has been associated with an increased risk of cancer. Hames finds that those people in his study who had low cholesterol concentrations and cancer also had lower blood concentrations of vitamin A.

Stamler suggests that people whose serum cholesterol is naturally low may either absorb dietary cholesterol inefficiently or excrete it efficiently. In either case, they would tend to have more sterols in their intestines than do people who eat the same diet but have higher cholesterol levels. Intestinal bacteria can convert sterols to carcinogens, which may explain why those people with low cholesterol are at a higher risk at least for colon cancer—if indeed they are. "If this hypothesis is true", says Stamler, "the way for people with naturally low cholesterol concentrations to protect themselves against cancer may be to eat a diet low in total fat and cholesterol and also to eat plenty of fiber to move the cholesterol out of their intestines".

It is not yet clear what this information means to anyone who is concerned about diet. Levy says that the NHLBI still recommends that those whose cholesterol concentrations are high try to lower them by dieting. But, he says, "To those who have suggested that the lower the (serum) cholesterol the better, the data on low cholesterol and cancer does not silence them but it should make them a little more cautious".

Although the American Heart Association recommends diets low in saturated fats and cholesterol, Scott Grundy of the Veterans Administration Hospital in San Diego, who heads the Heart Association's nutrition committees, says he thinks that for those whose serum cholesterol is below 200 mg "the reasons for changing the diet are not as compelling as for those whose cholesterol is 250, where the risk of heart disease is 4 to 5 times as high. There is no proof yet that lowering your cholesterol from 200 to 160 is beneficial. I'm not advocating that people push their cholesterol as low as

possible". But, he explains, since diet can lower cholesterol concentrations by only 10 to 15 per cent, no one with elevated cholesterol is likely to lower his cholesterol to anywhere near the range that may be associated with cancer.

At present, the NHLBI and the Heart Association are awaiting additional information on low cholesterol concentrations and cancer. The data to be presented at the NHLBI meeting in May, says Levy, "should enable us to see whether the association is real, how strong it is, and whether other factors impinge on it".

(Science, 211, 2489 (March 27, 1981) p. 1410-1411)

* Chlorination and Cancer *

* Thomas H. Maugh II in Science *

* 211(4438):694, 13 Feb. 81 *

* ... "New studies have strengthened the evidence *

* for an association between rectal, colon, and *

* bladder cancer and chlorinated water, according *

* to a recent report from the President's Council *

* on Environmental Quality (CEQ)....The increased *

* risk does not arise from the chlorine itself, but *

* from carcinogens produced by the action of chlo- *

* rine on naturally occurring organic compounds *

* in the water, particularly humic acids from the *

* soil....The new report, prepared for CEQ by *

* Kenny S. Crump and Harry A. Guess (Science *

* Research Systems, Inc., Ruston, Louisiana), *

* reviews five recent epidemiological studies.... *

* Most epidemiologists and cancer specialists *

* interviewed by Science agree that the evidence *

* linking chlorinated organic contaminants in *

* drinking water and an increase in cancer inci- *

* dence is becoming persuasive. Most, however, *

* also urge caution before any action is taken *

* as a result of the studies." *

* (Source: Current Contents - Life Sciences, *

* 24, 12(March 23, 1981) p 15) *

* *****

Disease Origins

The gene for sickle cell anemia, a disease found primarily among black people, appears to have evolved because its presence can render its bearer resistant to malaria. Such a trait would have obvious survival value in tropical Africa.

A person who has sickle cell anemia must have inherited genes for the disease from both parents. If a child inherits only one sickle cell gene, he or she will be resistant to malaria but will not have the anemia. Paradoxically, inheriting genes from both parents does not seem to affect resistance to malaria.

In the United States, where malaria is practically nonexistent, the sickle cell gene confers no survival advantage and is disappearing. Today only about 1 out of every 10 American blacks carries the gene.

Many other inherited diseases are found only in people from a particular area. Tay-Sachs disease, which often kills before the age of two, is almost entirely confined to Jews from parts of Eastern Europe and their descendants elsewhere. Paget's disease, a bone disorder, is found most often among those of English descent. Impacted wisdom teeth are a common problem among Asians and Europeans but not among Africans. Children of all races are able to digest milk because their bodies make lactase, the enzyme that breaks down lactose, or milk sugar. But the ability to digest lactose in adulthood is a racially distributed trait.

About 90 per cent of Orientals and blacks lose this ability by the time they reach adulthood and become quite sick when they drink milk.

Even African and Asian herders who keep cattle or goats rarely drink fresh milk. Instead, they first treat the milk with fermentation bacteria that break down lactose, in a sense predigesting it. They can then ingest the milk in the form of yogurt or cheese without any problem.

About 90 per cent of Europeans and their American descendants, on the other hand, continue to produce the enzyme throughout their lives and can drink milk with no ill effects.

(Science Digest, 89, 1 (January-February, 1981) p 56)

SERI's Low Energy Future

The SERI study, a copy of which has been made available to Science, breaks the U.S. economy into four sectors — buildings, industry, transportation, and utilities — and examines energy supply and demand in each of them separately.

The buildings sector offers perhaps the largest single area of savings, says SERI. Almost one-third of all the energy consumed in the United States is used to heat, cool, and illuminate buildings and to run appliances such as refrigerators and cooking stoves. This requires 13 Q of oil and gas directly and another 13 Q of primary energy converted to electricity. By 2000, SERI argues, investments in energy efficiency could reduce this demand by 8 Q and economic investments in solar technologies could cut the total by another 4 to 5 Q.

As for industry, higher energy prices are already leading to more efficient use of energy, and market forces can be expected to accelerate this process. But while most studies anticipate that industrial energy use will still rise significantly, along with industrial output, the SERI study argues that, with a mixture of tax changes and investment subsidies, energy demand in industry can be held roughly constant. The value of industrial output could grow by about 50 per cent over the next two decades with little increase in energy consumption. SERI concludes, and industry could derive between 13 and 25 per cent of its needs from renewable resources, chiefly biomass.

In the transportation sector, consumption of gasoline peaked in 1978 and most analysts believe that it has entered a long-term decline. The SERI study suggests that this decline can be accelerated in a cost-effective manner so that the energy required for transportation could be cut from the current level of 19.5 Q to between 12.6 to 16.5 Q by the end of the century. Moreover, it should be possible to meet 25 to 45 percent of those demands with alcohol, principally methanol derived from coal or biomass.

Like the other low energy growth studies, the SERI report argues that savings of these magnitudes will be cost-effective because, up to a certain point, investments in energy efficiency will save more energy than would be produced by an equivalent investment in energy supply.

(Science, 212, 4493 (April 24, 1981) p. 425)

Using solar ponds to store power from the sun
by Harry Tabor
(Abstract)

Subsequent to the petroleum crisis of 1973, many industrialized nations undertook programmes to harness the sun's radiation on a large scale, specifically as a source of electricity. One of the two main approaches has been ocean temperature energy conversion (OTEC). This very expensive development is applicable only to large installations. Here is discussed a different approach, that of 'solar ponds', which might be described as 'the poor man's OTEC'.

(Impact of Science on Society, 30, 4 (October-December 1980) pp 319-328)

*
* Farthest Known Galaxies Seen *
* Walter Sullivan in New York Times *
* 2 Mar 81, p. A1, B6 *
*
* ... "After 40 hours of observation conducted *
* over three years, astronomers have identified *
* a galaxy estimated to be 10 billion light- *
* years away. Previously the most distant *
* galaxy was estimated to be 8 billion light- *
* years away. The newest discovery was made *
* with a computerized image tube that processes *
* light collected by the 120-inch reflector of *
* the Lick Observatory, which is operated by *
* Univ. California. At the same time similar *
* methods also disclosed three other galaxies *
* at comparable distances. The discovery im- *
* proves the chances that objects will be seen *
* far enough away, and therefore far enough into *
* the past, to determine whether expansion of *
* the universe has been slowing sufficiently *
* to ultimately lead to a reversal of expansion *
* and eventual collapse.... All four discoveries *
* are apparently so-called radio galaxies, those *
* undergoing violent changes and radiating ex- *
* tremely large amounts of radio energy." *
*
* (Source: Current Contents - Phy. Chem. & *
* Earth Sciences, 21, 15 (April 13, 1981) *
* p 14) *
*

The Solar Bath-Tap

S. Pallis

(Abstract)

A conventional solar domestic water heating system can be retro-fitted with a third, solar tap over the bath. When a bath is being mixed, if water from the solar tap is now included in the mix instead of cold water, then draw-off of hot tap water is reduced. Total usage of solar water is simultaneously increased, lowering the solar store's average temperature. This results, at the collector, in increased operating time and efficiency, lowering the long term usage of auxiliary energy.

The energy saving is analysed and significant parameters are derived. The effect of storage capacity on this saving is discussed. An example of retrospectively adding a solar bath tap is worked out, based on a U.K. home with four occupants. The marginal rate of return on the cost of the modification is in this case shown to be about double the rate of return on the cost of the basic solar system. In the case of an initially fitted solar bath tap, advantage is shown to arise from a small associated increase in storage capacity.

(Solar Energy, 25, 6(1980) pp 531-536)

Swedes back coal to cut oil imports

Engineers in Sweden think that liquid fuels based on coal could help to cut the nation's oil imports by a third or more within a decade. Much of this saving could come from a purified coal slurry called Carbogel that Boliden, the mining, smelting and chemical company, is developing.

Boliden has every reason to support the idea: the company's own oil imports account for 1.2 per cent of Sweden's energy consumption. Swedish industry accounts for about 40 per cent of the country's total spending on energy, while 36 per cent of the country's imported oil is the energy source for space heating. The government provides loans for all industrial energy conservation schemes having a pay-back period greater than three years. Since 1974 it has paid out about £100 million, to help save one million tonnes of oil.

If Carbogel is applied successfully in electricity generating and district heating plants, as well as in industry, it would lessen Sweden's present heavy dependence on oil from the Middle East.

The Carbogel process dovetails with Boliden's existing know-how in separating non-ferrous metals and sulphur from low grade ores. The company makes Carbogel by grinding up coal—of any quantity—and removing the ash, heavy metals and inorganic sulphur. Then it adds water and a soap-like additive that disperses the purified coal dust evenly in a permanent suspension that looks like heavy fuel oil.

The dispersant is a well-known commercial chemical, says Boliden's technical director Gunnar Olgard. Boliden plans to use the sulphur and some of the other residues to help make other chemicals.

Carbogel can be pumped in pipelines and stored indefinitely, and it will not explode. Its thermal value is only 60 per cent that of the same volume of oil but it burns more cleanly. Existing oil-burning systems will burn Carbogel with a modified burner and related accessories, Olgard explains.

Boliden bought the rights to Carbogel in 1980 but will exploit it in partnership with Scania inventor, a Helsingborg company owned by Olle Siwersson, who devised the process.

"The market is so tremendously big that we can't have it for ourselves", says Olgard. "We'll be happy if we have just a-

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small percentage of it".

If all goes to plan, Boliden will, within a few years, import millions of tonnes of American coal each year. The company is already building grinding and flotation plants to make Carbogel and will establish a distribution network to supply the fuel to its own factories and to other customers in Sweden and the rest of Scandinavia.

(New Scientist, 89, 1239(February 5, 1981) p 340)

*
* Can Science Come Back to Islam? *
* Ziauddin Sardar in New Scientist *
* 88(124): 212-16, 23 Oct. 80 *
*
* ..."Though Islam exalts the use of reason, it also *
* places reason under the control of revelation. In *
* other words, in Islam, the use of reason is not *
* divorced from the ethics and morality of the exer- *
* cise. When the great physician al-Rhazi was asked to *
* make poisons he refused - saying that while he was *
* quite capable of doing so, his profession demanded *
* that he made only those drugs that would be used for *
* curing people and his religion forbade doing anything *
* that could possibly harm other members of society. *
* Al-Biruni, most exact of scientists, insisted that *
* his experimental work was subject to the moral *
* principles of Islam; for him revelation was the *
* supreme authority. The ethics and morality of Islam *
* are all pervasive; theoretical and experimental *
* sciences must both be guided by them." *
*
* (Source: Current Contents - Life Sciences, *
* 24, 11 (March 16, 1981) p 13) *
*

Sink found for some 'missing' carbon dioxide

As much as 1 gigatonne (10^9 tonne) of carbon may be stored each year in the previously disregarded "sink" of large marine plants according to S.V. Smith, of the Hawaii Institute of Marine Biology.

Smith's theory will greatly interest climatologists, concerned about the implications of a "greenhouse effect" in which the build-up of carbon dioxide in the atmosphere causes the atmosphere to heat up. They are baffled as to why the build-up is not proceeding even faster than observed.

Only about 50 per cent of the carbon dioxide released by burning fossil fuels seems to stay in the atmosphere, yet according to the oceanographers the seas cannot be taking up more than 40 per cent of the emissions of carbon dioxide that arise through human activities such as fuel-burning.

There is also some uncertainty about whether the world's forests are contributing to the carbon dioxide build-up or may actually be absorbing carbon dioxide: between 0.5 Gt and 5 Gt of carbon released each year remains unaccounted for.

Previous calculations of the global carbon cycle have included the contribution of small marine plants, the plankton that cover 3.6×10^8 sq.km. of the globe. But they have largely ignored the role of large plants (macrophytes) which occupy only about 2×10^6 sq.km. As Smith points out, however, macrophytes make up two-thirds of the ocean biomass; they play a relatively much bigger part in storing carbon than plankton (Science, vol 211, p 838).

Like forests on land, macrophytes in the ocean can respond to an increase in carbon dioxide concentration by growing bigger, effectively storing carbon. Microscopic plankton may grow more vigorously under the stimulus of carbon dioxide enrichment, but they rapidly run through their life cycles and release carbon back into the environment as carbon dioxide through decay.

Marine macrophytes are involved in a complex inter-play of processes including sinking of large plants to the sea bed for burial, transport of carbon into deep waters encouraging the growth of calcareous organisms whose chalky shells store carbon dioxide as carbonate Smith suggests that these activities contribute to "a single, complex

carbon sink", whose "quantitative significance on a global scale is not yet known", but which seems to be absorbing a significant part of the "missing" carbon dioxide being produced by human activities each year.

(New Scientist, 89, 1243 (March 5, 1981) p 604)

* ****

* The Browning of America *

* Jerry Adler et al. in Newsweek 97(8):
* 26-37, 23 Feb. 81 *

* ...Rain, in fact, is not the answer to
* the nation's most serious water problems.
* Even in the driest years, rain across the
* country enormously exceeds water use. The
* trouble is that the nation's water resour-
* ces are badly out of balance. The North-
* west has a big surplus, for example, while
* the agricultural states of the Southwest
* scrap for the last salty dregs of the
* Colorado River. The water wars Hollywood
* made famous in Chinatown have erupted once
* again, as dry Los Angeles tries to tap its
* wet neighbors to the north. The Federal
* government has spent billions of dollars
* to divert water so farmers can grow crops
* on arid land, but that creates trouble of
* another kind; mineral residue from decades
* of irrigation has poisoned once fertile
* soils. Pollution is a problem, too. Acid
* rain is killing the fish in the Adirondack
* lakes, and America's drinking water has
* been tainted with substances as exotic as
* PCB's and as commonplace as highway salt.
* Most alarming of all, vast underground
* reserves of water, deposited over thousands
* of years, have been seriously depleted in
* a matter of decades".

* (Source: Current Contents - Life
* Sciences, 24, 14 (April 6, 1981)
* p 8 *

* ****

The Ecology of an International Scientific Project

by Francesco di Castri, Malcolm Hadley
and Jeanne Damlamian

(Abstract)

Three specialists stress the desirability of developing multi-purpose, relatively low-cost schemes, built on strong local foundations and integrated internationally to share information and experience. The approach is problem-orientated, planners and local populations are involved, natural and social sciences are combined, and new criteria are developed for project evaluation. Co-operative research of this kind runs the risks of less planned control, less standardization of methodologies and comparability of results, and a higher risk of failure of some programme components. But overall results compensate for these risks.

(Impact of Science on Society, 30, 4 (October-December 1980)
pp 247-260)

*
* Mankind's Better Moments *
* Barbara W. Tuchman in American Scholar *
* 49(4): 449-63, Autumn 80 *
*
* "...If primitive man could discover how to trans- *
* form grain into bread, and reeds growing by the *
* riverbank into baskets; if his successors could *
* invent the wheel, harness the insubstantial air *
* to turn a millstone, transform sheep's wool, *
* flax, and worms' cocoons into fabric—we, I imagine, *
* will find a way to manage the energy problem. *
* Consider how the Dutch accomplished the miracle *
* of making land out of sea. By progressive enclo- *
* sura of the Zulder Zee over the last 60 years, *
* they have added half a million acres to their *
* country, enlarging its area by 8% and providing *
* homes, farms and towns for close to a quarter of *
* a million people. The will to do the impossible, *
* the spirit of can-do that overtakes our species *
* now and then, was never more manifest than in this *
* earth-altering act by the smallest of the major *
* European nations." *
*
* (Source: Current Contents - Phy. Chem. & *
* Earth Sciences, 21, 8 (Feb. 23, 1981) p 13) *
*

Neutrons as Research Tools (Extracts)

AERE Harwell announced recently a new service to industry based on the use of thermal neutron beams from the DIDO and PLUTO materials testing reactors and the 'condensed matter target cell' of the new 136 MeV electron linear accelerator, Peter Schofield and Lynne Garne explain

Behind the launching of this service lies 30 years of experience in the use of neutron diffraction and scattering techniques in the study of the structure and other properties of materials at the molecular level. For the past 14 years Harwell's programme has been funded as a joint venture with the Science Research Council, through its Science Board, enabling some hundreds of University research workers to carry out experiments at Harwell. However, it is an indication of the importance of neutron beams in scientific research that this joint programme now accounts for only a small fraction of the £ 16 million a year spent by the SRC in supporting UK participation with France and Germany in work with the High Flux Beam Reactor at the Institut Laue-Langevin, Grenoble, and in constructing its own Spallation Neutron Source (SNS) at the Rutherford and Appleton Laboratories for use beyond 1984. Such research covers the whole of the science of 'condensed matter'—encompassing crystalline and amorphous solids, adsorbed layers on surfaces, liquids, liquid crystals, polymers and biological systems.

From the beginning, Harwell scientists have been at the forefront in exploiting new uses of neutron beams. In the early days work was concentrated on the study of crystal structures, of magnetism and of liquids, though an important element of the programme was the measurement of cross-sections for energy exchange between neutrons and moderating materials in order to predict the energy distributions of neutrons in thermal reactors. From the latter grew the use of inelastic neutron scattering in molecular spectroscopy which stimulated the interest and involvement of many chemists. More recently, improvements in diffraction methods, especially over the last decade the introduction of small angle scattering techniques, have interested mineralogists, metallurgists, colloid scientists, polymer scientists and biologists in the potential of neutron scattering.

The field of neutron beam studies is still expanding both in basic research, for example in probing the mechanisms of phase transitions, and in the area of applied materials research. Harwell's programme is now firmly concentrated at the latter end

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of this spectrum, and includes work on materials associated with the nuclear power programme, reactor fuel, cladding, moderating and structural materials and, increasingly, work funded outside in the nuclear vote....

(Atom, 292 (February, 1981) pp 42-47)

* * * * *

* Notable Quotes *

* "Scientific research is a social activity....To understand the nature of science, we must look at the way scientists behave towards one another, how they are organized, and how information passes between them. The young scientist does not study formal logic, but learns by imitation and experience a number of conventions that embody strong social relationships—learns to play a role in a system by which knowledge is acquired, sifted, and eventually made public property". *

* - John Ziman *

* "It is to science that we owe the liberation of mankind from ancient and rigid forms of thought. Today these forms are nothing but bad dreams—and this we learned from science. Science and enlightenment are one and the same thing." *

* - Paul Feyerabend *

* * * * *

Kidney surgeons tune to radio waves

Surgeons at Radcliffe Infirmary, Oxford, will soon have an extra test to decide whether kidneys are suitable for transplant. According to the technique, called topical magnetic resonance (TMR), technicians will place a kidney inside a powerful cylindrical magnet in Oxford University's Department of Biochemistry. Pulses of radio waves pass through it for two or three minutes, causing molecules of adenosine di- and triphosphate-ADP and ATP- in the kidney to emit radio waves. These are detected and analysed, to provide information about the kidney's metabolism.

Researchers have so far evaluated TMR on 10 kidneys which were not used for transplant. Eventually, TMR will be an additional test for kidneys and other organs provided for surgery. The equipment will be moved to the Radcliffe Infirmary for this purpose in about a month's time.

In TMR, the radio signals returning from tissue provide biochemical data about the organ or tissue being investigated: effectively, it makes possible biochemical studies of tissue inside the body. Oxford Research Systems, an off-shoot of Oxford Instruments set up to manufacture TMR equipment, has developed the technique to enable doctors to do such checks on just one organ or a small region inside the body that they want to investigate.

This can be done by enclosing a region as small as a kidney in an intense magnetic field while magnetic forces outside the enclosed region are made to vary randomly. The effect is to alter the wavelengths of the radio signals from inside the enclosed area only so that they can be distinguished from signals from the surrounding region. Thus doctors can follow the progress of the kidney in its new host as well as checking it before transplant. TMR can also help to estimate the degree of brain or body damage caused by a stroke or heart attack.

The first TMR machines have internal cavities large enough to hold a kidney, a human arm or leg for tests, or a small monkey for research purposes. The next generation of machines, will have a cavity large enough to take a human body. This will allow work to begin on checking the effects of heart attacks and strokes. Other planned areas of research include following the progress of tissue healing after surgery, investigating the relation of pain to tissue damage and the extent of the biochemical abnormalities caused by genetic defects.

(New Scientist, 89, 1240 (February 12, 1981) p 411)

Minerals formed by Organisms

by Heinz A. Lowenstam

(Summary)

Organisms are capable of forming a diverse array of minerals, some of which cannot be formed inorganically in the biosphere. The initial precipitates may differ from the form in which they are finally stabilized, or during development of the organism one mineral may substitute for another. Biogenic minerals commonly have attributes which distinguish them from their inorganic counterparts. They fulfill important biological functions. They have been formed in ever-increasing amounts during the last 600 million years and have radically altered the character of the biosphere.

(Science, 211, 4487 (March 13, 1981) pp 1126-1131)

Darwin and Social Darwinism

Michael Ruse in Albion

12(1):23-36, Spring 80

..."Darwin's position on man and his capacities was a fairly direct extension of Darwin's general thinking about the evolution of organisms, especially animals. Starting from Malthus, but going far beyond Malthus, Darwin saw humans as a product of natural selection brought on by the struggle for existence. Moreover, although he disclaimed 'might is right' doctrines, he saw something of this ilk going on in his day. 'The more civilized so-called Caucasian races have beaten the Turkish hollow in the struggle for existence.' His only worry was that because of modern medicine, many of the unfit were surviving and reproducing: 'No one who has attended to the breeding of domestic animals will doubt that this must be highly injurious to the race of man.'

(Source: Current Contents - Phy. Chem. & Earth Sciences, 21, 6 (Feb. 9, 1981) p 12)

The age of the Weddell Basin

by John L. LaBrecque &
Peter Barker
(Abstract)

The deep oceanic basin occupied by the Weddell Sea separates the East Antarctic craton from the Antarctic Peninsula, a largely post-Palaeozoic orogenic belt. An understanding of the tectonic evolution of the basin would resolve most of the remaining problems of Gondwanaland reconstruction, which revolve around the relative positions of these two fragments and South America. Norton and Sclater conclude that Indian Ocean marine geophysical data essentially support the Smith and Hallam fit, but the unacceptable overlap of undoubtedly old continental crust on the Antarctic Peninsula and Falkland Plateau implies relative motion between the Peninsula and East Antarctica. Such motion is not required by the reconstruction of Barron and others which, however, can be criticized on other grounds. The marine geophysical observations within the intervening ocean basins have proved useful in formulating plate tectonic reconstructions. Fracture zone trends, seafloor spreading type magnetic anomalies, crustal heat flux, and crustal depth all provide clues to the timing and direction of the continental motions. The acquisition of geophysical data from the Weddell Sea region has been slow. However, the combined interpretation of the two largest data sets extant now being undertaken, seems likely to provide a more tightly constrained Gondwanaland solution. As a first step, we report here an estimated age for the Weddell Sea floor in the area bounded by 60° and 73° S, 50° and 35° W.

(Nature, 290, 5806 (April 9, 1981) pp 489-492)

Cracks in rocks under stress

by Barry Atkinson

(Extracts)

Microcracks influence many of the physical properties of rocks. Strength, transport, elastic and inelastic characteristics are all highly dependent upon the size, shape, number and distribution of microcracks. These physical properties change dramatically as crack characteristics are modified under stress.

In earthquake prediction, the exploitation of oil, gas and water bearing formations, nuclear waste disposal, and heat extraction and storage, the prediction of in-situ physical properties from models of rock microcracks is of great importance but has, so far, been rather unsuccessful. The basic problem is that, despite many laboratory studies, we have only a rudimentary idea of the actual modifications that cracks undergo in stressed rocks. M.L. Batzle, G. Simmons and R.W. Siegfried of MIT have recently attempted to overcome this problem by making direct observations of crack closure in granite and diabase under uniaxial compressive stress (J. geophys. Res. 85; 7072, 1980).

The MIT group placed a small hydraulic press inside a conventional scanning electron microscope (SEM) so that they could subject cylinders about one cm in diameter and two cm long to uniaxial stresses of up to 30 MPa. A portion of the lateral side of the core was ground flat and bombarded with ionized argon to remove the damaged surface before examination in the SEM. Stress-strain measurements were also made on similar cores in the press but outside of the SEM. Although SEM studies have been made before on specimens subjected to tensile in situ stresses, this is the first time that a compressive stress has been so studied.....

A problem arises, however, because most studies of stressed cracks in rocks have been made on low-porosity, well-cemented crystalline rocks. Less well-cemented, high-porosity sedimentary rocks with more point contacts and fewer interlocking grains have quite different initial preferred orientations and distribution of microcracks. Recent experimental studies have shown that the differences in peak strength, the localization of deformation to give a main fault, and some water-weakening effects can be qualitatively explained in terms of the initial microstructure (Hadizadeh, J., Thesis, University of London, 1980).

Two limitations of the MIT study are that we are not sure their observations are typical of the bulk of their specimens. They examined sections that were within 1 mm of the surface, and the

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role of stress corrosion crack growth was not investigated in the high-vacuum environment of the SEM. In situ tensile tests, however, show that stress corrosion can be a significant factor (Swan, G. Res. Rep., Tulea 1980: 01, University of Lulea).

It would now be valuable to extend in situ observations to higher stresses and temperatures and more complex polyaxial stress states. At present this is not possible and one is forced to examine at zero stress and ambient conditions specimens that have been retrieved from more exotic conditions.

(Nature, 290, 5808(April 23, 1981) p 632)

Science and Genesis

Isaac Asimov in Skeptical Inquirer

5(2): 42-51, Winter 80-81

... "Some writers, notably astronomer Robert Jastrow, have found similarities in the Biblical account of creation and astronomy's theory of the big bang. However, 'What counts is not that astronomers are currently of the opinion that there was once a big bang, in which an enormously concentrated 'cosmic egg' that contained all the matter there is exploded with unimaginably catastrophic intensity to form the Universe. What counts is the long chain of investigation that led to the observation of the isotropic radio wave background (shortwave radio waves that reach Earth faintly, and equally, from all directions) that supports that opinion. So when the astronomer climbs the mountain, it is irrelevant whether theologians are sitting at the peak or not, if they have not climbed the mountain. As a matter of fact, the mountain peak is no mountain peak; it is merely another crossroad. The astronomer will continue to climb. Jastrow seems to think the search has come to an end and there is nothing more for astronomers to find. There occasionally have been scientists who thought the search was all over. They are frequently quoted today, because scientists like a good laugh."

(Source: Current Contents - Life Sciences, 20
24, 11 (March 16, 1981) p 13

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